

UNITED STATES PATENT APPLICATION FOR:

**RECOVERY TECHNIQUES IN  
MOBILE NETWORKS**

Inventors:

**Son PHAN-ANH**

**Balint BENKO**

**Auvo HARTIKAINEN**

**Markku VERKAMA**

**Heikki EINOLA**

**Stefano FACCIN**

Prepared by:

Antonelli, Terry, Stout & Kraus, LLP  
1300 North 17th Street, Suite 1800  
Arlington, VA 22209  
Tel: (703) 312-6600  
Fax: (703) 312-6666

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## Field of the Invention

### Description of the Related Art

Figure 1 illustrates the architecture of the network disclosed in the above-noted Technical Report. The elements shown with asterisks are elements which have been duplicated for figure layout purposes only. These duplicated elements belong to the same logical element in the reference model.

Unfortunately, the network disclosed in the Technical Report fails to include any protection of the TA of a 3G All-IP subscriber from loss. Furthermore, the network disclosed in the Technical Report fails to protect the IP address of a subscriber in the case of a reset situation of a network element realizing CSCF functionality, that is, a CSCF, thereby preventing recovery after a reset of the network element. Still furthermore, the network disclosed in the Technical Report fails to protect the location information of a subscriber after a CSCF crash, thereby preventing recovery after a CSCF crash.

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#### SUMMARY OF THE INVENTION

An object of the present invention is to provide a technique for recovering location information of a subscriber in a mobile network including forwarding a registration request from the subscriber to an S-CSCF including the subscriber's TA and then forwarding an AL (Application Level) location update from the S-CSCF to an HSS including the subscriber's TA and the S-CSCF address and storing data including the subscriber's TA and the S-CSCF address in the HSS so as to be protected against loss.

Another object of the present invention is to provide a technique for recovering location information of a subscriber in a mobile network including forwarding a registration request from the subscriber to an S-CSCF including the subscriber's TA and then forwarding an AL location update from the S-CSCF to an HSS including the S-CSCF address and storing data including the subscriber's TA in a non-volatile memory the S-CSCF so as to be protected against loss.

Yet another object of the present invention is to provide a technique for recovering location information of a subscriber in a mobile network including upon an S-CSCF receiving a call setup request for the subscriber from an I-CSCF, forwarding a route request to a UMS and receiving a home address of the subscriber and then forwarding the call setup request from the S-CSCF to a home agent at the home address of the subscriber and then forwarding the call setup request from the home agent to the subscriber and subsequently forwarding an address update from the subscriber to the S-CSCF.

## BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and a better understanding of the present invention will become apparent from the following detailed description of example embodiments and the claims when read in connection with the accompanying drawings, all forming a part of the disclosure of this invention. While the foregoing and following written and illustrated disclosure focuses on disclosing example embodiments of the invention, it is clearly understood that the same is by way of illustration and example only and the invention is not limited thereto. The spirit and scope of the present invention are limited only by the terms of the appended claims.

The following represents brief descriptions of the drawings, wherein:

Figure 1 illustrates the architecture of a 3G All-IP mobile network.

Figure 2 illustrates reaching a called party after losing LA (Location Area) information in a legacy mobile network.

Figure 3 illustrates failure to reach a called party after losing TA information in a 3GPP All-IP mobile network.

Figure 4A illustrates sending subscriber TA to S-CSCF and then forwarding it to HSS at registration.

Figure 4B illustrates an example of reaching a called party after losing TA information in a mobile network in accordance with the present invention.

Figure 5 illustrates the signal flow in the case of a recovery after a CSCF crash in accordance with another embodiment of the present invention.



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routed to the subscriber using this address regardless of its current point of attachment to the Internet, and it may continue to communicate with others after moving to a new link. The movement of a subscriber away from its home link is thus transparent to transport and higher-layer protocols and applications.

A mobile subscriber is always addressable by its home address, whether it is currently attached to its home link or is away from home. While it is at home, packets addressed to its home address are routed to it using conventional Internet routing mechanisms in the same way as if it were never mobile. Since the subnet prefix of its home address is the subnet prefix (or one of the subnet prefixes) on the subscribers' home link (it is the mobile subscribers' home subnet prefix), packets addressed to it will be routed to its home link.

While a subscriber is attached to some foreign link away from home, it is also addressable by one or more care-of addresses, in addition to its home address. A care-of address is an IP address associated with a mobile node while visiting a particular foreign link. The subnet prefix of a subscriber's care-of address is the subnet prefix (or one of the subnet prefixes) on the foreign link being visited by it; if it is connected to this foreign link while using that care-of address, packets addressed to this care-of address will be routed to the subscriber in its location away from home.

The association between a subscriber's home address and care-of address is known as a "binding" for the subscriber. It typically acquires its care-of address through stateless or stateful Address Autoconfiguration, according to the methods of IPv6 Neighbor Discovery. Other methods of acquiring a care-of address are also possible, such as static preassignment by the

owner or manager of a particular foreign link, but details of such other methods are beyond the scope of this discussion.

While away from home, a mobile subscriber registers one of its care-of addresses with a router on its home link, requesting this router to function as the "home agent" for it. This binding registration is done by the subscriber sending to the home agent a packet containing a "Binding Update" destination option; the home agent then replies to the subscriber by returning a packet containing a "Binding Acknowledgment" destination option. The care-of address in this binding registered with its home agent is known as the subscriber's "primary care-of address". The subscribers' home agent thereafter uses proxy Neighbor Discovery to intercept any IPv6 packets addressed to the subscribers' home address (or home addresses) on the home link and tunnels each intercepted packet to the subscribers' primary care-of address. To tunnel each intercepted packet, the home agent encapsulates the packet using IPv6 encapsulation, with the outer IPv6 header addressed to the subscribers' primary care-of address.

Keeping the address of the S-CSCF ensures that a call to a subscriber can be routed to the destination node, that is, the S-CSCF. Keeping the current TA of the subscriber ensures that a call made to the subscriber which arrives at the S-CSCF can finally reach the subscriber.

As illustrated in Figure 2, in legacy mobile networks, such as GSM, the information on the serving MSC/VLR (stored in the HLR) is adequate. That is, the called party can be reached even after the loss of the subscriber LA information by a searching/paging mechanism. In step 1, the current V-MSC/VLR for a called party is first located and in step 2 a setup toward the V-MSC/VLR is performed. In step 3, upon a loss of the LA

information, the called party is paged in all cells under the V-MSC/VLR.

On the other hand, as illustrated in Figure 3, in the 3G All-IP network, no such searching mechanism is available, so that the information of the current S-CSCF (stored in the HSS) is insufficient to reach the subscriber upon the loss of the subscriber TA. In step 1, S-CSCF is located and in step 2 a setup toward the S-CSCF is performed. However, in step 3, in the absence of the TA of the called party, the called party is not reachable.

The applicants have determined that the TA of a 3G All-IP subscriber should be protected against loss with the same level of security as that for the Serving CSCF (S-CSCF). The applicants have proposed options to protect the TA of a subscriber, namely, one option in which the TA is forwarded to the Home Subscription Server (HSS) and another option in which there is a security backup of the TA within the CSCF. The TA of the subscriber should be forwarded to the HSS at registration and downloaded from the HSS to the S-CSCF during recovery. Still another option is to have a permanent IPv6 (Internet Protocol Version 6) address allocated to the subscriber and to have the subscriber update its current Care-of Address (part of the TA) to the Home Agent upon obtaining the current TA.

As noted above, in accordance with the present invention, various options are available for implementing protection and recovery of the subscriber TA.

In the first option, as illustrated in Figure 4A, "a safe copy" of the subscriber's TA is forwarded to the HSS for storage and protection. The TA must enjoy the same level of protection against loss as the S-CSCF address. The TA and other data can then be restored to the S-CSCF upon the earlier loss of the data by the S-CSCF. It is noted that the subscriber's TA is stored



In providing a solution to the above-noted problem in accordance with the third option, the following assumptions are made:

1) IPv6 is adopted for IP addressing and a subscriber is given a home address at subscription time. This home address is stored in a UMS (User Mobility Server).

2) The subscriber is in an area assigned to an S-CSCF and has registered with it and has provided its' TA, that is, the current address where the subscriber is reachable. Such an address is not the static home address but rather what is called the "Care-Of Address". Whenever the S-CSCF has to forward signaling to the mobile subscriber, it uses the Care-of Address. The subscriber has also registered its current Care of Address with its Home Agent.

3) The S-CSCF restarts due to a fault and loses the information about the mobile station.

The following procedure in accordance with the present invention, as illustrated in Figure 5, may, for example, be used for mobile terminating call delivery:

When an incoming call reaches a CSCF in the home network, either from another IP based terminal or from an MGCF (Media Gateway Control Function), the interrogating CSCF queries the UMS based on the alias dialed by the calling party.

During registration, the UMS has stored information about the S-CSCF and information as to how the mobile subscriber can be reached. More particularly, the UMS has stored the address of the S-CSCF, that is, the address where CC (Call Control) signaling must be forwarded. At this point, two scenarios are possible:

1) the information in the UMS regarding the S-CSCF is still valid; the UMS returns the address of the S-CSCF and the



